APPARATUS FOR REMOVING MATERIAL FROM PRESSURISED SPACE

The present invention relates to an apparatus for removing solid materials, and particularly to an apparatus for removing finely divided solids from a pressurised space to which there are connected members for feeding the material to be treated into a process taking place in a pressurised space and for removing the created products from said pressurised space.

From a pressurised space, material is usually removed so that the pressure in said space is reduced, and the material outlet is opened for removing the material from the space. When the pressure is desired to be maintained in said space, there is installed in connection with the material outlet, a valve or valves whereby the material can be removed from the space without essentially altering the pressure. The employed valves can be either electric, hydraulic or pneumatic, in which case the material usually causes a pressure to the valve flap. When the pressure surpasses a given limit, the valve is opened, and the material is discharged from the space. When the amount of discharged material rises to a level where the pressure caused by said material is sufficiently reduced, the valve is closed. This kind of valve can be for example an eccentric flap valve, where the pressure is located on the other side of the valve flap. However, the valve is not suited for finely divided solids, because in connection with the closing of the valve, in between the valve flap and the valve housing, there remain solid particles that reduce the compactness of the sealing achieved by the valve and finally make the valve unfit for use.

Pneumatically sealed valves are also used for removing material from a pressurised space. A pneumatically sealed calotte valve has a uniform pneumatic sealing, but otherwise the structure corresponds in principle to a spherical valve, in which case the drawbacks are a large size and a high price. Known pneumatically sealed flap valves are in form symmetric in relation to the

axis, in which case the drawback is their sealing at the axis. This type of valve arrangement is also easily blocked.

From the FI patent 68,977 there is known a filter device that with gearing and actuator is used in an over pressure space, and the filtering products thereof, i.e. the finely divided solids, are removed through a lock gate from the over pressure space. The employed lock gate is for instance a blade lock or a spiral conveyor, in which case the solids flow is utilised in the operation of the lock gate. Now the finely divided solids to be removed can to a certain extent be prevented from getting in between the locking member of the lock gate and the wall, because the lock gate as such does not perform a motion opposite to the circulation direction of the solids, but the solids always flow to the same direction. However, the operation of this kind of a lock gate is dependent on the solids flow, because the solids flow as such maintains the compactness achieved by means of the lock gate as the position of the blades alters, in order to maintain the over pressure in the over pressure space.

The US patent 5,362,403 specifies a filtering device and method for removing the filter cake from the filtering part of the filtering device. In said method, the filter cake is transferred by a spiral conveyor to a discharge shaft. In the bottom part of said discharge shaft, there is installed a locking member which is hydraulically controlled. According to the US patent 5,362,403, the locking member together with the discharge shaft forms a pressure lock in between the filtering device and normal air pressure. The operation of the locking member is controlled by two electrodes attached to the discharge shaft, so that when the filter cake has reached a certain height in the discharge shaft, the filter cake creates an electric lock in between the electrodes, the control member opens the locking member and the filter cake is discharged through the discharge shaft. The removal of the filter cake is thus carried out in a discontinuous way, and in connection with the removal, it is possible that the pressure is reduced in the filtering device proper, too.

The object of the present invention is to eliminate some of the drawbacks of the prior art and to achieve an improved apparatus with a simpler structure and a lower price for removing filtered material from pressurised space, said apparatus functioning automatically according to operating pressure and material flow. The essential novel features of the invention are apparent from the appended claims.

According to the invention, the conveyor transfers in a pressurised space filtered material obtained from the filter to a discharge conduit, from where the filtered material is transferred to normal air pressure via an adjusting member located at the opposite end. By means of said adjusting member, the surface height of the filtered material in the discharge conduit is maintained essentially on the same level on a substantially continuous basis. When the surface height in the discharge conduit surpasses a predetermined value, the aperture of the adjusting member is increased. Thus the flow speed of the filtered material increases, and the surface height in the discharge conduit is reduced to a desired, predetermined value. Respectively, when the surface height falls under a predetermined value, the aperture of the adjusting member is diminished in order to return the surface height to the desired, predetermined value.

In the apparatus according to the invention, the adjusting member installed in the discharge conduit includes at least two at least partially overlapping adjusting elements, which are provided with ports for letting the filtered material flow through the adjusting member. The total area of said ports falls within the range of 5 - 20 %, advantageously 10 - 15 % of the total area of the adjusting element. Moreover, in relation to each other the adjusting elements are arranged so that at least one of the adjusting elements can be moved. When the adjusting elements are moved with respect to each other, the ports provided in different elements can be matched, at least in a partly overlapping fashion, so that through said ports, the filtered material can be made to flow

from the discharge conduit to normal air pressure. Respectively, when the adjusting elements are moved in relation to each other so that the ports in the separate adjusting elements are not matched, the flowing of the filtered material is prevented.

According to the invention, in order to move the separate adjusting elements of the adjusting member in relation to each other, at least one of the adjusting elements is connected to a moving member. Said moving member is operated pneumatically, hydraulically or electrically. Depending on the mode of operation of the moving member, the adjusting member can be connected to the moving member either directly or via a separate transmission member. The employed transmission member can be for instance a lever arm or a piston, or said transmission member can be made of several parts, in which case it comprises for example a servo valve, a pneumatic cylinder and a lever arm.

In the apparatus according to the invention, the operation of the adjusting member is controlled by a control member which measures the surface height of the filtered material in the discharge conduit. Preferably the measuring is carried out by means of a measuring sensor installed outside the discharge conduit. Advantageously the measurement takes place by means of ultrasound, for instance, or then the change caused by the filtered material in the support structure of the discharge conduit is utilised in the measurement.

When using ultrasound, at least one ultrasonic sensor is employed for measuring in an essentially continuous fashion the surface height of the filtered material contained in the discharge conduit. In the control unit of the apparatus according to the invention, the obtained result is compared with the desired, predetermined surface height value. If the measuring result differs from said predetermined value, the control unit controls the adjusting member moving member, so that the surface height is returned to the desired, predetermined value.

When applying the strength change caused by the material in the supporting structure of the discharge conduit while measuring the filtered material surface height, outside the discharge conduit, in connection with the measuring sensor, there is installed at least one actuator whereby the strain caused by the filtered material in the supporting structure of the discharge conduit can be measured. Said actuator can be for example a bellows member made of some elastic material, so that on the basis of the elastic shortening of said bellows member, the change caused by the filtered material in the supporting structure of the discharge conduit can be determined. As an alternative, said actuator can be a tension-measuring member which determines the tension caused in the supporting structure by the filtered material. In the control unit of the apparatus of the invention, the obtained measuring result of the change in the support structure is compared, in the same fashion as when using ultrasound, with the predetermined supporting structure change caused by the desired surface height. On the basis of said comparison, the control unit controls the adjusting member, so that the surface height is returned to the desired value.

When using the apparatus according to the invention, by keeping the surface height of the filtered material essentially continuously on a desired, predetermined level, the filtered material serves as a pressure lock. Moreover, the filtered material and the pressure contained inside the filtering device direct a pressure force to the adjusting elements of the adjusting member, so that the adjusting elements are pressed against each other. When the surfaces of the adjusting elements that are nearest to each other are advantageously essentially smooth, the pressure force presses said adjusting elements together in an essentially compact fashion, in which case the pressure leak taking place via the adjusting member is as small as possible.

The invention is explained in more detail below, with reference to the appended drawing, wherein

figure 1 shows a preferred embodiment of the invention in a schematical side-view illustration,

figure 2 shows another preferred embodiment of the invention in a schematical side-view illustration,

figure 3 is a top-view illustration of an adjusting element according to the invention, and

figure 4 is a top-view illustration of an another adjusting element according to the invention.

According to figures 1 and 3, a conveyor 2 installed inside a pressurised filter 1 conveys material 11 filtered in a filter 1 to a discharge conduit 3. To the discharge conduit 3, to its filtered material discharge end, there is attached an adjusting member 4. The adjusting member 4 includes two concentric elements 5 and 6 which are provided with ports 7. In relation to each other, said adjusting elements 5 and 6 are advantageously installed, so that one adjusting element 5 is installed permanently, whereas the other adjusting element 6 is installed movably with respect to the axis 8. In order to move the adjusting element 6, said element 6 is connected to a control unit 12 by intermediation of a lever arm 9, a pneumatic cylinder 14 and a servo valve 13.

While the adjusting member 3 is in operation, in the immediate vicinity of the discharge conduit 3, there is installed an ultrasonic sensor 10, which measures, in an essentially continuous manner, the surface height 15 of the filtered material 11 contained in the discharge conduit. In the control unit 12 of the apparatus, the measuring result obtained from the ultrasonic sensor 10 is compared with the desired, predetermined value. If the measuring result differs from the predetermined value, the control unit 12 operates a servo valve 13, which further controls the pneumatic cylinder 14 connected to the lever arm 9 in order to move the adjusting element 6 in relation to the adjusting element 5, so that the surface height of the filtered material 11 in the discharge conduit 3 is returned to the desired, predetermined value.

According to figure 2, in the discharge conduit 21, there are attached shoulders 22 that support the discharge conduit 21. In between said shoulders 22 and the support surface 23, there are installed actuators 24, i.e. bellows members made of some elastic material, which members receive the changes caused by the filtered material in the pressure of the discharge conduit 21. The change received by the bellows members 24 is measured by means of a force measuring sensor 25. In the control unit 26, the measuring result given by the force measuring sensor 25 is compared with the change causing the desired, predetermined value of the surface height. If the measuring result differs from the desired value, the adjusting member 27 provided in the bottom part of the discharge conduit 21 is manipulated, so that in the discharge conduit 21, there can be maintained the desired surface height of the filtered material. Accordingly, if the surface height level 28 surpasses the desired, predetermined value, the adjusting elements 29 and 30 of the adjusting member 27, provided with ports, are moved in relation to each other, so that from the discharge conduit 21, there is discharged filtered material through the adjusting elements 29 and 30 to further processing. Said adjusting elements 29 and 30 are installed concentrically with respect to the axis 31, so that at least one of the adjusting elements 29 and 30 can be moved in relation to the axis 31. To the axis 31, there is connected a lever arm 32, whereby the adjusting element or elements 29 and 30 are moved in order to create an advantageous material flow from the discharge conduit 21 to outside it.

Figure 4 illustrates an advantageous manner for locating the ports 33 in the adjusting elements 29 and 30.